REMARKS

This application has been carefully reviewed in light of the Advisory Action dated September 21, 2004 and the Office Action dated July 9, 2004. Claims 22, 29, and 58 have been amended. A Request for Continued Examination is concurrently filed herewith. Applicant reserves the right to pursue the original claims and other claims in this and other applications. Please reconsider the above-referenced application in light of the amendments and following remarks.

Claims 22-35 and 58 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Chiang in view of Moslehi. The rejection is respectfully traversed.

The Advisory Action, dated September 21, 2004, states that "the claim language [claim 22] of 'comprising' does not preclude additional layers being formed." Applicant respectfully disagrees with this position; however, in order to expedite prosecution, claim 22 has been amended to recite that the top heat-radiating layer in Applicant's claimed copper interconnect structure is formed from approximately 100 Å to approximately 1000 Å thick. The cited references do not teach or suggest this feature.

The Office Action, dated July 9, 2004, acknowledges that Chiang does not "disclose the method of forming the heat-radiating passivation layer of aluminum nitride, wherein said heat-radiating layer is formed from approximately 100 angstroms to 1000 angstroms thick." (Office Action, pg. 3). The Office Action relies upon two embodiments in Moslehi for this disclosure. Both embodiments, however, do not teach or suggest a top heat-radiating layer formed from approximately 100 Å to approximately 1000 Å thick.

For example, in the first embodiment, Moslehi discloses two deposition processes to form two separate layers over the metallization structure. The first deposition process deposits a first layer to a controlled thickness of 50 Å to 200 Å of a dielectric material such as AlN (Col. 14, lines 19-22). The second deposition process deposits a second layer to form a hermetically-sealed top insulating passivation overlayer (Col. 14, lines 42-45). Moslehi's second layer, in other words, is the top passivation layer.

Moslehi does not teach or suggest that the top passivation layer comprises aluminum nitride. Moslehi merely discloses that the first layer comprises aluminum nitride. Moslehi does not teach or suggest a top heat-radiating layer comprising aluminum nitride.

Moreover, Moslehi does not teach or suggest a thickness for the second layer. A *prima facie* case of obviousness has not been set forth since Moslehi does not teach or suggest a thickness that overlaps Applicant's claimed range for a top heat-radiating layer. See M.P.E.P. § 2144.05. Accordingly, Moslehi does not teach or suggest a "top heat-radiating layer," as recited in claim 22.

In a second embodiment, Moslehi discloses in Col. 15, lines 1-24, three separate deposition steps to form three separate layers over a metallization structure. Again, Moslehi's top layer is the passivation layer. In this case, however, Moslehi's top layer has a minimal disclosed thickness of 5000 Å. This is five times thicker than Applicant's claimed thickness.

In the second embodiment, the first layer is a silicon dioxide deposition layer (Col. 15, lines 2-5). The second layer is silicon nitride or silicon oxynitride that is about 5000 Å thick. The third and top layer is a high-thermal conductivity insulating layer

such as aluminum nitride (Col. 15, lines 9-11). Moslehi's third layer, however, is formed to be at least 5000 Å to over 1 μm thick (Col. 15, line 9).

As such, Chiang and Moslehi do not teach or suggest a method of forming a copper interconnect structure by "forming a first contact opening. . . forming a conductive plug in said first contact opening; forming a second insulating layer . . . forming a second contact opening in said second insulating layer; forming a barrier layer . . . forming a copper conductor over said barrier layer; and forming a top heat-radiating layer . . . wherein said top heat-radiating layer is formed from approximately 100 Å to approximately 1000 Å thick," as recited in amended claim 22.

Moreover, the cited references do not teach or suggest forming a heat-radiating layer on an upper surface portion of a first conductive plug and forming a second conductive plug on the heat-radiating layer as recited in claim 29. Similarly, the cited references do not teach or suggest forming a conductive plug, forming a first copper conductor plug over the conductive plug, forming a heat-radiating layer on an upper surface portion of the first copper conductor plug, and forming a second copper conductor plug over the first copper conductor plug and in contact with the heat-radiating layer, as recited in claim 58.

In FIGS. 9 and 23, Chiang discloses the formation of more than one level of interconnects. A contact plug consisting of titanium nitride layer 40 provided underneath a tungsten layer 41 is disclosed. An interconnect channel 51 is formed over the contact plug. The interconnect channel consists of a titanium nitride barrier layer 60 and a copper metal layer 61. The titanium nitride barrier layer 60 is in contact with the tungsten layer 41. Adjacent to the titanium nitride barrier layer 60 is a layer of silicon nitride 23 provided as an etch-stop layer. A passivation layer is provided as element 98 over the second interconnect structure 97. A similar embodiment is described in Chiang's FIG. 23.

Chiang, however, does not teach or suggest depositing a second conductive plug on the heat-radiating layer or that a heat-radiating layer is formed on top of a first copper conductor plug with a second copper conductor plug in contact with the heat-radiating layer. The second conductive plug 61, 60, in Chiang's FIG. 9, is deposited on the first conductive plug 41, 40. The passivation layer 98 is provided on top of the second interconnect structure. A second conductive plug is not formed on passivation layer 98.

As such, the cited references do not teach or suggest a method of forming an interconnect structure by "forming a contact opening in an insulating layer . . . forming a first conductive plug within said contact opening; forming a heat-radiating layer . . . wherein said heat-radiating layer is formed from approximately 100 Å to approximately 1000 Å thick; and depositing a second conductive plug on said heat-radiating layer," as recited in amended claim 29.

Similarly, the cited references do not teach or suggest a method of forming a copper interconnect structure by "forming a first contact opening . . . forming a conductive plug . . . forming a second insulating layer over said conductive plug . . . forming a second contact opening in said second insulating layer; forming a barrier layer in said second contact opening; forming a first copper conductor plug over said barrier layer; forming a heat-radiating layer on an upper surface portion of said first copper conductor plug . . . and forming a second copper conductor plug over said first copper conductor plug in contact with said heat-radiating layer," as recited in amended claim 58.

Claim 23-28 depend from claim 22 and are similarly allowable along with claim 22. Claim 30-35 depend from claim 29 and are similarly allowable along with claim 29. Withdrawal of the § 103(a) rejection for claims 22-35 and 58 is respectfully solicited.

In view of the above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to pass this application to issue.

Dated: October 12, 2004

Respectfully submitted,

By_____

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